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ABSTRACT

This paper presents a means of evaluating answers to comprehension questions by analyzing the oral language used in the answers to the questions according to the average number of words per communication unit, a measure of linguistic and cognitive growth, in order to determine the effectiveness of comprehension questions asked at two cognitive levels to stimulate the higher cognitive processes. In two research studies students were asked questions at two levels of comprehension. Their responses were tape recorded, analyzed, and compared. It was found that comprehension questions asked at the higher cognitive level elicited answers that were significantly longer than the answers to the questions asked at the lower comprehension level. The study determined that the effectiveness of comprehension questions to stimulate higher cognitive processes can be evaluated by analyzing the language children use in answering the questions according to the number of words of the communication unit. (Author/LL)

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TITLE: Evaluating Answers to Comprehension Questions

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The research presented in this paper has been taken in part from the doctoral dissertation entitled, "The Relationship between the Type of Question, Stimuli, and the Oral Language Production of Children," under Professor Robert B. Ruddell, Universtiy of California, Berkeley, 1974, for which Dr. Smith was awarded "Promising Researcher of the Year" by the National Council of Teachers of English.

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Purpose

Much has been written about instructional questions, about the effect of questions upon student thinking, and about the need to increase the percentage of comprehension questions asked at higher cognitive levels. This research presents a means of evaluating answers to comprehension questions in reading, listening, visual perception, and the related content areas, an avenue of research that has only begun to be investigated.

Background Information

A major purpose of education is to enhance children's thinking. Piaget (4) viewed a child's verbal accommodation to learning experiences as having a lasting effect only when it affected the means of organizing one's experiences. The role of the question in the learning process was found to be significant in the organization of experiences. Piaget's research relies heavily upon the use of questions in his famous methode clinique.

Taba (8), basing research heavily upon Piaget, found classroom questions to have an enormous influence on the critical thinking of students. Taba found that through systematic instruction based upon questioning, the teacher could stimulate higher cognitive processes of children.

Cognitive processes have been related to the level of questions. Ruddell (5) explained that questions asked at interpretive and applicative levels stimulate higher

cognitive processes than factual questions. Factual questions merely involve experience plus the recall of immediate information for the answers, whereas answers to interpretive questions involve the modification of the content by analysis, reconstruction, or inference of relationships. Answers to applicative questions involve creative problem solving. Ruddell viewed questioning as a valuable instructional tool to develop the cognitive ability in reading and listening.

Lowery (3), stressing the importance of the cognitive levels of instructional questions, categorized questions into two intellectual levels, narrow questions requiring certain "correct" answers with planned, convergent outcomes, and broad questions requiring divergent or unplanned answers with at least several different acceptable responses including affective evaluations.

Although much has been written about the classification of comprehension questions into various cognitive levels, and about how the levels of questions affect the cognitive processes, few researchers have explored the effectiveness of questions to elicit answers indicative of the use of higher cognitive processes. Little has been written about the evaluation of answers to comprehension questions, or about the relationship between the level of questions asked and the cognitive processes involved in the answers to the questions.

In evaluating the answers to comprehension questions,

Gall (1) pointed out that together with the use of the data to defend the response, it would be reasonable to expect a correlation between the response length and its quality.

In evaluating answers to comprehension questions one notes that the language used in the answers can provide evidence of the relationship between the levels of questions asked and the cognitive processes involved in the answers. Research in language has shown a correlation between the length of children's grammatical structures and their level of cognitive development.

Noting the relationship of sentence structure and Piaget's stages of cognitive development, Sinclair-de-Zwart (6) found linguistically higher order grammatical structures among children who had reached higher operational stages of cognitive development. When asked to describe the differences between two objects, children in the preoperational stage singled out the differences in short sentences, such as, "This one is long; This one is short;" whereas the children who had operationally mastered conservation of quantity expressed the double difference in one structurally more complex statement, "This one is longer and thinner than the other one."

From longitudinal language research, Loban (2) found that among school children there is a positive correlation between the advance in grades and the increasing average

word-length of the communication unit, the grammatical independent clause and its modifiers. During the first seven years of school, children, as they advance in cognitive development, produce more communication units and increase the average number of words in the communication units each year. Loban (2) stressed that the average number of words per communication unit is a measure of significance based on evidence that a high average of words per communication unit was coupled with increased complexity of grammatical structures.

Guided by research indicating that the average length of the communication unit of children increase in length as they advance to higher stages of cognitive development, and that the cognitive levels of comprehension questions affect the thought processes of children, Smith (7) hypothesized that the language used by children in answer to comprehension questions asked at a higher cognitive level would result in significantly longer average communication units than would the answers to comprehension questions asked at a lower cognitive level.

Method of Research A

In the first of two research studies, Smith (7) made an investigation of the oral language of children in answers to questions asked at the factual level, a lower cognitive level, and the interpretive level, a higher cognitive level, as part of doctoral dissertation research.

Smith (7) selected thirty subjects from each grade two and grade four in order to compare two stages of cognitive development, the preoperational period represented by grade-two subjects, and the concrete operations period, represented by grade-four subjects. The sixty subjects were chosen at random from one California elementary school representing predominately the lower and middle class Caucasian socio-economic level.

Each individually interviewed subject was asked four factual level questions and four interpretive level questions about each of three stimuli. Each subject was presented with three separate stimuli, a reading stimulus consisting of a story which the subject read; a listening stimulus consisting of a story which was read to the subject by the examiner; and a multiple-picture stimulus consisting of three pictures. After the presentation of each stimulus, four factual and four interpretive questions were asked. The factual, the lower cognitive level questions, required the subject to utilize experience plus memory for the answers. The interpretive, the higher cognitive level questions, involved the modification of the content of the data by analysis, reconstruction, or inference of relationships.

The following are examples of the questions and answers:

Factual Question: Who had a wallet?

Answer: a lady/

Factual Question: What happened to the wallet?

Answer: she left it at the store/

Interpretive Questions: What do you suppose the lady will do with the wallet?

Answer: give it back to the lady/

Interpretive Question: When the lady knows her wallet is lost, what might she do?

Answer: go back to the store and get it/

The tape recorded language used by the subjects in their answers to the questions was transcribed and analyzed according to the average number of words per communication unit used in answers to the questions.

The communication unit is a linguistic unit that cannot be further divided without loss of its meaning. It consists of a grammatically independent clause with any of its modifiers, and includes no more than one such clause. The sentence, "I see a girl with a dog," consists of one communication unit. The meaning would be lost if the sentence were segmented into smaller units, "I see a girl" "with a dog." The sentence, "I see a girl and I see a dog," consists of two communication units since the sentence consists of two independent grammatical structures, "I see a girl," "and I see a dog." However, the sentence, "I see a girl and a dog." consists of only one communication unit since it cannot be divided into two meaningful grammatical structures.

Results of Research A

Smith made comparisons of the average lengths of the communication units elicited in the oral language of the subjects of both grades two and four in answers to the factual and to the interpretive questions. The research findings showed that in answering interpretive comprehension questions, the subjects of grade four responded by using significantly longer communication units than did the subjects of grade two, as calculated by the two-sample t-test statistical analysis. Subjects in grade four used an average of 9.84 words per communication unit compared with 7.27 words used by the subjects of grade two. (See Table 1.)

Table 1

ORAL LANGUAGE ELICITED IN ANSWERING QUESTIONS

(Comparing Two Levels of Questions)

Grade	Average Words per Communication Unit		t-Value	N
	Interpretive Q.	Factual Question		
2	7.27	3.56	10.77*	30
4	9.84	3.74	12.04*	30

* Significant at .001 level.

In answers to comprehenstion questions asked at the interpretive level compared to the questions asked at the factual level the subjects in both grades responded in significantly longer average communication units to the comprehension questions asked at the interpretive level as calculated by the matched pairs t-test. In answer to

the factual questions, however, the subjects in grade four did not respond at a higher cognitive level by using significantly longer average communication units than the subjects of grade two. The average length of the responses for grade-four subjects was only 3.74 words and 3.56 words for the subjects of grade to in answers to the factual questions. (See Table 1.)

Using the average length of the communication unit as a measure of cognitive and linguistic growth, Smith viewed the interpretive comprehension questions, eliciting significantly longer answers, to be more effective in stimulating higher cognitive processes. The research results indicated that the type of questions asked influenced the cognitive levels of the subjects of grade two and grade four. Questions at the interpretive level prompted answers that were two to three times longer than the answers to the factual questions which indicated that the interpretive comprehension questions were more effective in stimulating higher cognitive processes for the subjects of both grades measurable by determining the average number of words per communication unit elicited in the answers to the questions.

Method of Research B

Using the average length of the communication unit for language growth measures, Smith analyzed the oral language used by students in answers to questions designed by teachers participating in a graduate level teacher education project implemented through the cooperation of the School of

Education of the University of California, Berkeley, and the Lawrence Hall of Science. Both elementary and secondary teachers participated in a graduate training program aimed at improving comprehension questions in their classroom instruction in reading as well as in the content areas. The teachers designed various instructional questions at two cognitive levels, the narrow level and the broad level. The narrow questions consisted of direct information questions requiring the recall or the recognition of information, and focusing questions requiring the students to develop a particular idea or answer by leading him toward it through clues as to what the answer is or the appropriate method of obtaining the answer.

The following are examples of the questions and answers:

Narrow Question: What did the little girl find in the woods?

Answer: a gunniwolf/

Broad Question: What does the gunniwolf remind you of?

Answer: he looks like a real mad wolf that's going to eat something up/

The broad questions allowed for several acceptable answers related to it. The broad questions included open-ended questions allowing the student to explore freely without restrictions and with only minimal guidance toward developing the answer, and valuing questions asking for an affective evaluation or an explanation of the criteria used in making

an evaluation.

Tape recordings of the classroom questions were collected from twenty teachers as they asked questions during individual or group lessons. Smith transcribed the tape recordings and analyzed the language used by the students in their answers to the questions asked at the narrow and the broad levels of comprehension according to the average number of words per communication unit.

Results of Research B

The analysis of the oral language used by students of the twenty classes from the various grades in answers to 1,511 questions showed that the average number of words used in the answers to the broad questions at the higher level of comprehension was 4.46 words in answer to 568 questions compared to an average of 3.13 words in answers to 943 narrow questions at the lower cognitive level of comprehension. (See Table 2.) Again, the questions asked at the higher cognitive level elicited responses that were considerably longer than the answers to the questions at the lower cognitive level.

Table 2

ORAL LANGUAGE ELICITED IN ANSWERING QUESTIONS

Cognitive Level of Question	Number of Questions	Average Words per Communication Unit
Narrow (Lower)	983	3.13
Broad (Higher)	568	4.46

Although the higher cognitive questions elicited longer average responses than the lower cognitive questions, in examining the responses to specific questions not all broad questions were consistent in eliciting longer responses. For example, the answers to broad valuing questions concerned about personal feelings usually elicited brief answers indicative of lower cognitive level responses. For example, in answer to the valuing question, "How would you feel?" the brief response might be, "glad," "bad," "terrible," "sad," or "happy." It is necessary to look at the answers to specific questions of each category in order to determine whether the answer is reflecting the expected cognitive level responses.

Conclusions and Implications for Education

The answers to comprehension questions can be evaluated by measuring the number of words used in the answers to the questions. The effectiveness of comprehension questions to elicit answers indicative of higher cognitive processes can be determined by the analysis of the language used in the answers according to the number of words in the communication units used in the answers. Based upon the evidence that the communication unit is a measure of linguistic and cognitive growth, it is viewed that the higher cognitive questions eliciting answers in significantly longer average communication units are more effective in enhancing the use of higher cognitive processes and in improving comprehension.

Comprehension in reading, listening, and visual perception, as well as comprehension related to the various content

areas can be improved by designing and including in the instructional programs a greater percentage of questions that elicit answers indicative of the use of higher cognitive processes and by the evaluation of the answers to the questions in order to determine whether the questions are actually eliciting answers at the cognitive levels for which they were designed.

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